

CLAIMS

1. A robot wrist with a plurality of rotatable parts arranged in series with each other, comprising at least a first wrist part (1) arranged in use to be mounted to a robot arm or automation machine to enable rotary movement of the first wrist part about a first axis, yes, a second wrist part (2) journaled in the first wrist part, wherein each wrist part is arranged with one or more gear members to drive a said rotary movement of any said wrist part relative to said another wrist part, **characterised** in that at a generatrix of the conical surface of least one of said gear members is arranged as a concave bevel gear with a negative bevel angle (C_n) relative to a plane (P) perpendicular to the rotation axis (A_1 , A_2) of said gear member.

2. A robot wrist according to claim 1, **characterised** in that at least one of said gear members is arranged with a convex bevel gear with a positive bevel angle relative to a plane perpendicular to the rotation axis (A_1 , A_2) and at least one other said gear member is arranged as a concave bevel gear with a negative bevel angle.

3. A robot wrist according to claim 1, **characterised** in that the negative bevel angle (C_n) lies in the range between 0 and -20 degrees.

4. A robot wrist according to claim 1, **characterised** in that the negative bevel angle (C_n) lies in the range between -8 and -12 degrees.

5. A robot wrist according to claim 1, **characterised** in that the gear member is an annular bevel gear.

6. A robot wrist according to claim 1, **characterised** in that said second wrist part (2) is arranged with a said gear member (12, 13) with the negative bevel angle (C_n).

7. A robot wrist according to claim 4, **characterised** in that the negative bevel angle (C_n) of the gear member of said second wrist part (2) is arranged to engage a gear member (10) of said first wrist part (1).

8. A robot wrist according to claim 1, **characterised** in that each of said gear members has a hollow opening through which an inner protection hose (4) is arranged.

9. A robot wrist according to claim 8, **characterised** in that the inner protection hose is arranged so as to pass through the inside of the wrist parts arranged in a single circular arc when the wrist is in a bent position.

10. A robot wrist according to claim 8, **characterised** in that the inner protection hose (4) passing through the inside of the wrist parts (1, 2, 3) has the same total length when arranged in each of a bent and a straight position.

11. A robot wrist according to claim 8, **characterised** in that the inner protection hose is a hose with a substantially cylindrical wall.

12. A robot wrist according to claim 11, **characterised** in that the inner protection hose is a hose with a cylindrical wall that has a straight and parallel wall cross-section.

13. A robot wrist according to claim 12, **characterised** in that the inner protection hose is a hose with a wall cross-section in the form of a wave.

14. A robot wrist according to claim 12, **characterised** in that the inner protection hose comprises an articulated hose comprising circular sections of at least two different diameters.

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15. A robot wrist according to claim 13, **characterised** in that the inner protection hose is formed of a polymeric material combined with at least one metal reinforcing member.

10 16. A robot wrist according to claim 15, **characterised** in that the inner protection hose comprises a fluoropolymer.

15 17. A robot wrist according to claim 15, **characterised** in that the metal reinforcing member comprises a plurality of metal rings.

18. A robot wrist according to claim 13, **characterised** in that the metal reinforcing member comprises any of a spiral wire or a helical wire.

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19. A robot wrist according to claim 18, **characterised** in that the metal rings, spiral wire or helical wire of the hose are attached to the outside surface of the polymeric material.

25 20. A robot wrist according to claim 18, **characterised** in that the rings, spiral wire or helical wire of the hose are embedded in the polymeric material.

30 21. A robot wrist according to claim 1, **characterised** in that a plurality of hoses and/or cables are arranged inside said inner protection hose (4) inside the wrist parts (1, 2, 3).

22. A robot wrist according to claim 21, **characterised** in that the plurality of hoses and/or cables are twisted to a

predetermined extent inside the inner protection hose and comprise any from the list of: hose, wire, feed rod, cable.

23. A robot wrist according to claim 22, **characterised** in that the plurality of hoses and/or cables are arranged installed inside the robot wrist twisted to a predetermined extent through 180 degrees.

24. A robot wrist according to claim 1, **characterised** in that the negative bevel angle of gear member of said second wrist part (2) is arranged facing a third wrist part (3).

25. A robot wrist according to any of claims 1-24, **characterised** in that the third wrist part (3) is journaled in the second wrist part (2) to enable rotary movement of the third wrist part relative the second wrist and the second wrist part relative the first.

26. A robot wrist according to claim 25, **characterised** in that a gear member (10, 11) of the first part (1) is arranged to engage a gear member (12) of the second part such that the second wrist part transfers effect to rotatably drive a gear member (14) of the third wrist part (3) engaged by a second gear member (13) of the second part.

27. A robot wrist according to claim 26, **characterised** in that the second part gear members (12, 13) transferring effect to the third part gear member are arranged in the second part such that their axes of rotation A1, A2 are at an inclined angle to each other.

28. A robot wrist according to claim 26, **characterised** in that a first part gear member (10) and a third part gear member (14) are convex bevel gears with a positive gear angle and a

second part gear member (12, 13) is a concave bevel gear with a negative bevel angle.

29. Use of a robot wrist according to any of claims 1-28 for an internal or an external surface treatment operation or painting operation with an industrial robot.

30. Use of a robot wrist according to any of claims 1-28 for a welding operation with an industrial robot.

31. Use of a robot wrist according to any of claims 1-28 for a picking and/or packing operation with an industrial robot.

32. Use of a robot wrist according to any of claims 1-28 for a machine tending operation with an industrial robot.